WikiNeuron: Semantic Neuro-Mashup

http://neuroweb3.med.yale.edu/mediawiki/index.php/WikiNeuron

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Introduction

- There has been an increasing number of Bio-Wiki projects including Gene Wiki, Wikiproteins, Wikipathways, Proteopedia, SNPedia, etc
- Why not creating a collaborative and semantic-enabled Wiki for the neuroscience domain
- If we have "*calling on million minds for community annotation in Wikiproteins*", why not "*calling on trillion neurons for community annotation in WikiNeuron*"

WikiNeuron Protoype

- It is conceived as collaborative knowledge acquisition, annotation, and integration for neurosciences
- It is implemented using Semantic MediaWiki (SMW), which is a semantic extension of MediaWiki that drives large-scale community projects like Wikipedia
- This prototype is developed by SenseLab in collaboration with NIF (Neuroscience Information Framework)

Overview of SMW

- It is page-centric. There are different types of pages:
  - Categories: support of hierarchical structure
    - E.g., Person is a category, Scientist can be a subcategory of Peron
  - Articles: they are category instances/members
    - E.g., The home page of Jone Smith is a page of the Category Person
- Properties: attributes that are used to annotate page contents and relate pages
  - E.g., Address, Age, Sex, Email, and Friends are properties of Jone Smith

Overview of SMW

- It provides an internal semantic query language
- It supports SPARQL endpoint
- It supports Open Linked Data through a utility that allows RDF data export
- It has extensions such as the Halo extension that allows incorporation of ontologies into semantic annotation of wiki content.

WikiNeuron Semantic Structure

- Categories: Brain, Database, Literature
- These categories and their subcategories describe databases, literature, brain functions, and brain structure (at different levels of granularity).
- In addition to these categories, properties are defined to annotate data/literature and integrate them with brain functions/structure.
- Many of WikiNeuron's categories/properties come from the NIF ontology

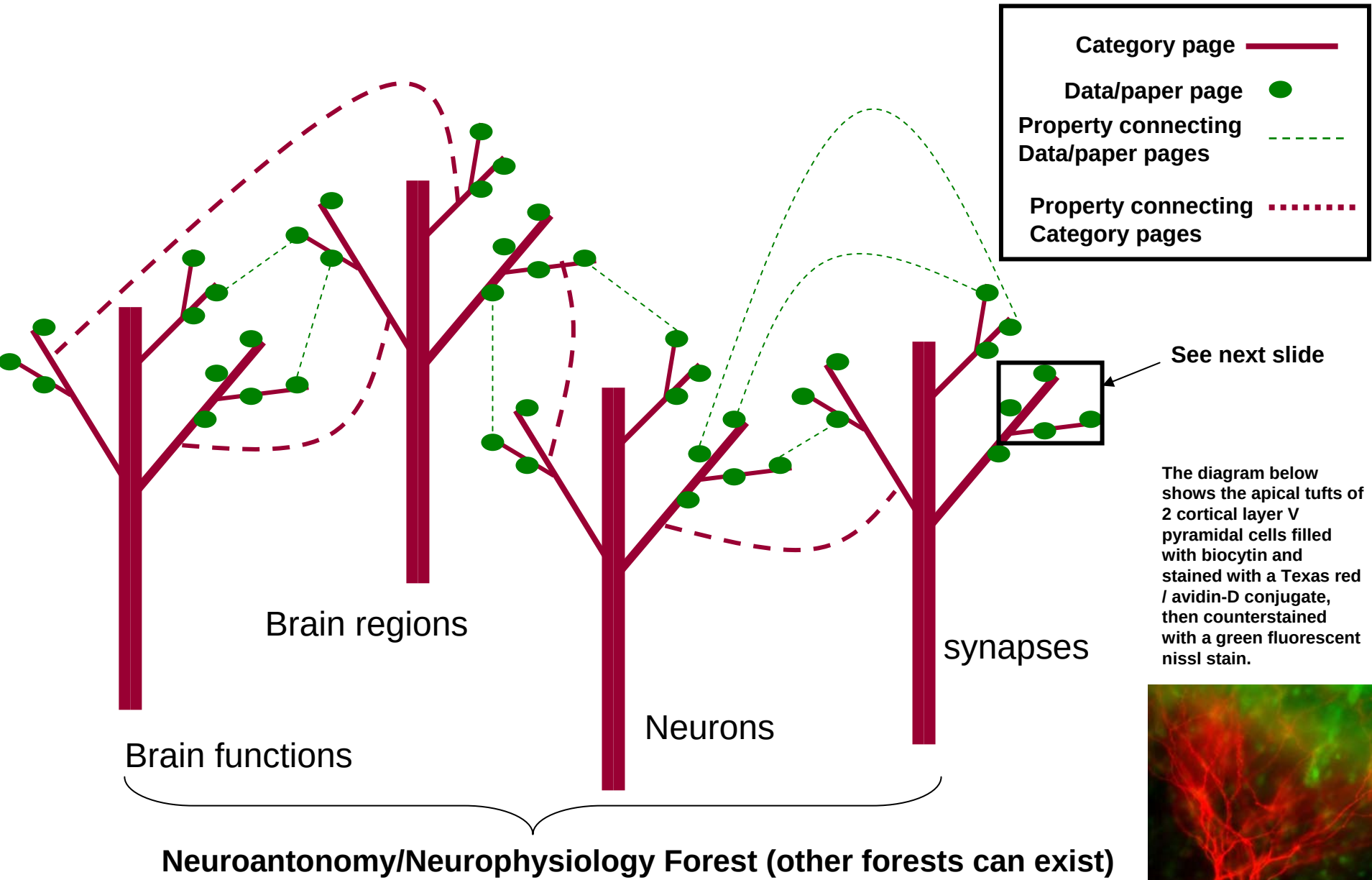
Brain Category Trees

- Brain
  - Brain Region
    - Cerebellum, Hippocampus, Neocortex, …
  - Neuron
    - Principal neuron
      - CA1 Pyramidal Neuron, Cerebellar Purkinje Neuron, …
    - Interneuron
      - Cerebellar Granule Cell
  - Neuronal Properties (Synapses)
    - Receptor
      - GABA-A receptor, …
    - Transmitter
      - Dopamine, …
    - Current
      - IA, …

Other Categories

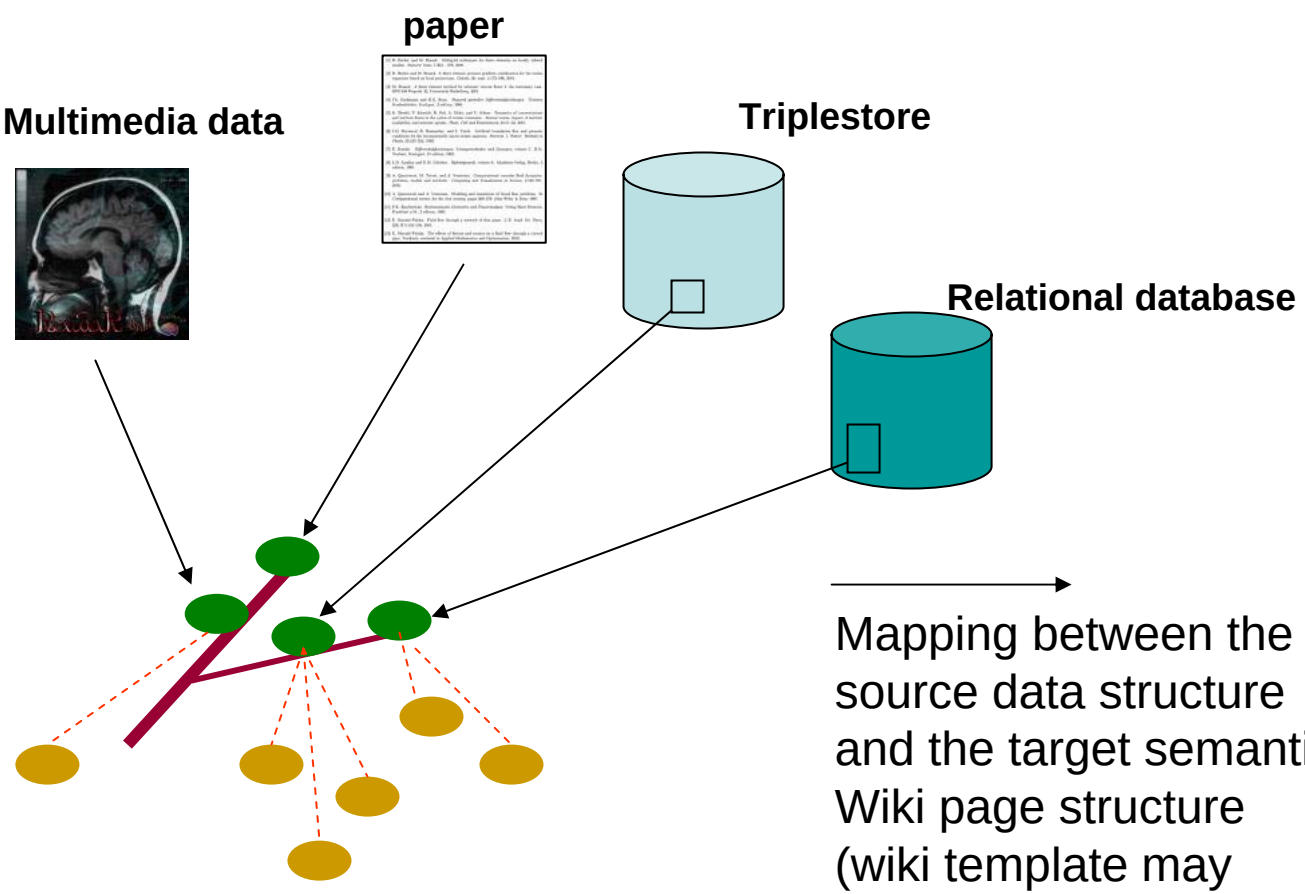
- Database
  - Neuroscience Database, …
- Scientific literature
  - PubMed Articles, …
- Person
  - Contributors, administrators, …

Semantic Trees of the Mind



The diagram below shows the apical tufts of 2 cortical layer V pyramidal cells filled with biocytin and stained with a Texas red / avidin-D conjugate, then counterstained with a green fluorescent nissl stain.

Automatic Generation and Import of Data/Literature Pages



Demo

http://neuroweb3.med.yale.edu/mediawiki/index.php/WikiNeuron

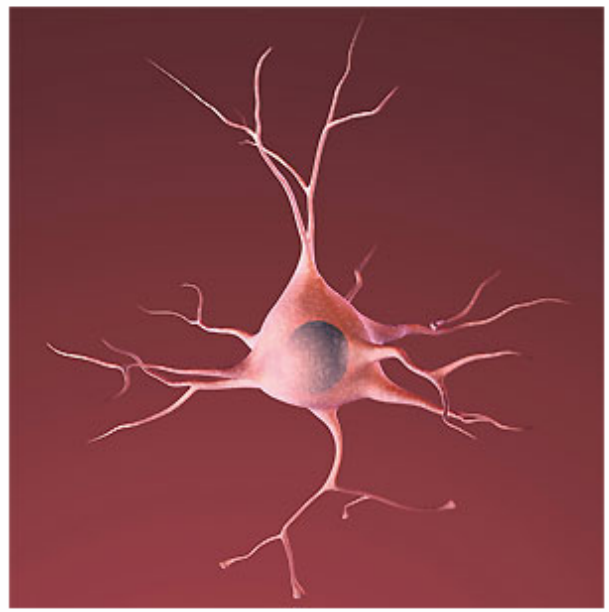
page | discussion | edit | history | delete | move | unprotect | unwatch | refresh

WikiNeuron

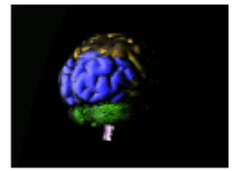
WikiNeuron is designed for the scientific community to collaborate and contribute knowledge in the neuroscience domain. It is currently implemented using Semantic MediaWiki. This initial prototype is developed by SenseLab in collaboration with NIF. It has the following inter-related components.

- Brain functions and structure
- Neuroscience databases
- PubMed articles

We are planning to expand WikiNeuron by collaborating with communities including Neuroscience Information Framework (NIF), International Neuroinformatics Coordinating Facility (INCF), Alzforum/SWAN, Semantic Web for Health Care and Life Science Interest Group, National Center for Biomedical Ontology, Semantic Wiki community and so on.



Human Brain [edit]

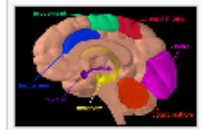


- The part of CENTRAL NERVOUS SYSTEM that is contained within the skull (CRANIUM). Arising from the NEURAL TUBE, the embryonic brain is comprised of three major parts including PROSENCEPHALON (the forebrain); MESENCEPHALON (the midbrain); and RHOMBENCEPHALON (the hindbrain). The developed brain consists of CEREBRUM; CEREBELLUM; and other structures in the BRAIN STEM. (MeSH)
- The brain is divided into the following lobes: frontal (red), temporal (yellow), parietal (blue) and occipital (green). (See the animation to the right.)
- One of our goals is to integrate data between brain functions and brain structure. We divide the brain structure into different levels: brain regions, neurons, and neuronal cell membrane properties (see 3D brain explorer by function and structure.)

Brain Functions [edit]

Brain Function Tree

Video links



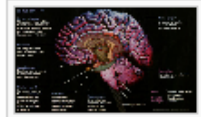
The diagram shows some of the general brain functions and the brain regions that are responsible for these functions.

Brain Regions [edit]

Brain Regions (with neurons)

See a more comprehensive list of brain regions at NIF

Video links



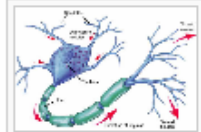
This diagram shows some of the brain regions.

Neurons [edit]

The basic cellular units of nervous tissue. Each neuron consists of a body, an axon, and dendrites. Their purpose is to receive, conduct, and transmit impulses in the nervous system. (MeSH)

Neuron Tree

Video links

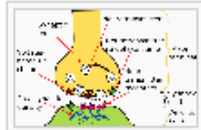


This diagram shows the basic structure of a neuron.

Neuronal Cell Membrane Properties [edit]

Neuronal Properties

Video links



This diagram shows the major elements involved in a

Brain Functions

[edit]

- Brain Function Tree
  - Learning
    - Memory
    - Cognition
  - Perception
    - Space Perception
    - Visual Perception
  - Thinking
    - Problem Solving
    - Speech and Language
    - Substance Abuse

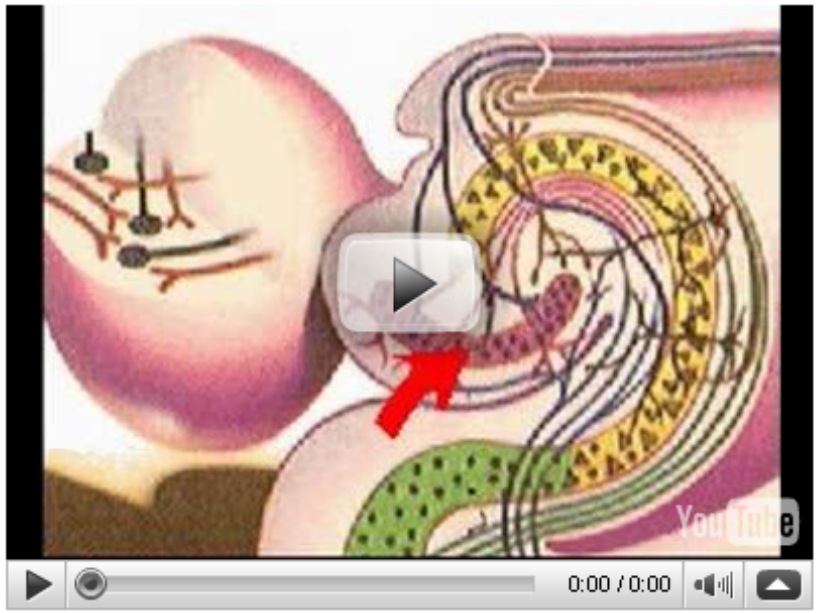
The diagram shows some of the general brain functions and the brain regions that are responsible for these functions.

Video links

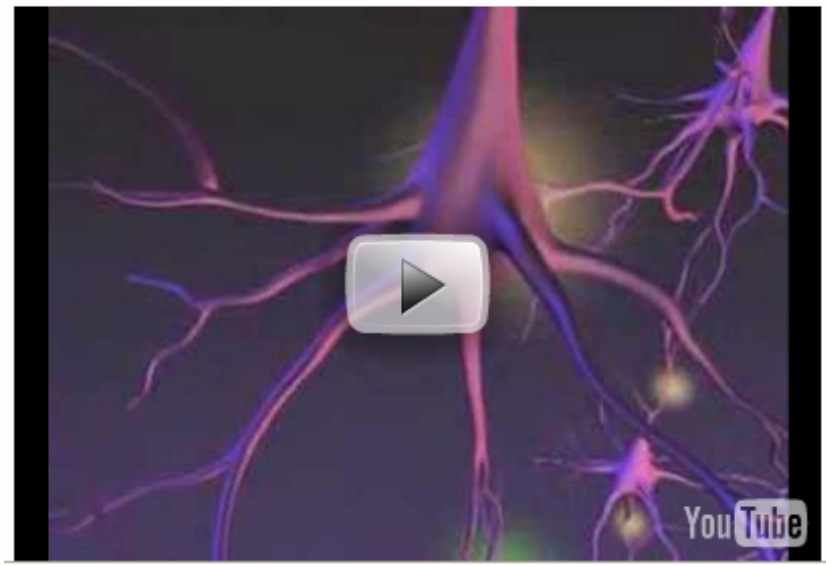
Brain function videos

Back to brain page

How the Body Works: Center of Emotion and Memory



Stress and Memory



Brain Regions [edit]

- **Brain Regions (with neurons)**
  - [Dentate]
  - Hippocampus
  - [Diencephalon]
  - [Retina]
  - [Thalamus]
  - Neocortex
  - [Olfactory cortex]
  - [Olfactory bulb]
  - [Olfactory epithelium]
  - [Dorsal cochlear Nucleus]
  - Cerebellum
  - [Neostriatum]
  - [Substantia nigra]

This diagram shows some of the brain regions.

See a more comprehensive list of brain regions at NIF

Video links

Article title	Id	NeuronamesLink	De
Abducens nerve fibers	birnlex_1689	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=593	
Abducens nerve root	birnlex_1277		
Abducens nucleus	birnlex_1366	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=580	
Accessory basal amygdaloid nucleus	birnlex_2686	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=231	
Accessory cuneate nucleus	birnlex_2634	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=765	
Accessory medullary lamina	birnlex_1626	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=218	
Accessory nerve fiber bundle	birnlex_916	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=789	
Accessory nerve root	birnlex_1580	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=700	
Adenohypophysis	birnlex_1581	http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=390	

Brain Regions

[edit]

- **Brain Regions (with neurons)**
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  - [Retina]
  - [Thalamus]
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  - Cerebellum
  - [Neostriatum]
  - [Substantia nigra]

This diagram shows some of the brain regions.

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Video links

Cerebellum

Contents [show]

Chinese Translation [edit]

小脑

Definition [edit]

Part of the rhombencephalon that lies in the posterior cranial fossa behind the brain stem. It is concerned with the coordination of movement.
See NIF for more information

Functions [edit]

- Motor

Neurons [edit]

- Cerebellar Purkinje Neuron (edit/view)

Data Pages [edit]

[to be added]

Paper/Article Pages [edit]

[to be added]

External Web Pages [edit]

- GENSAT
- WikiPedia
- 维基百科 (Chinese version of Wikipedia)
- ClinicalTrials.gov

Category: Cerebellum

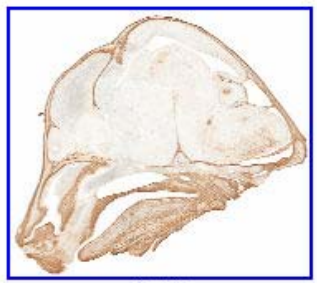
GENSAT Anatomy Showcase

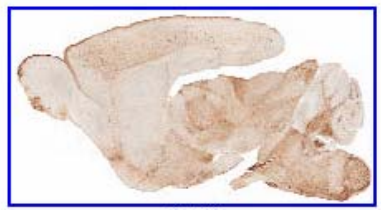
Images displayed in the Anatomy Showcase are from mouse lines selected by GENSAT staff because they have especially interesting and/or potentially useful expression patterns in given brain regions. Brightfield images of EGFP immunohistochemistry are at the top of the page; confocal images of EGFP fluorescence are below. For example, BAC reporter lines highlighted in the confocal section of the Showcase express sufficient levels of EGFP so as to be useful for many electrophysiology or biochemical investigations. If you have comments on these or other expression patterns, we welcome your input (Contact the Annotation Core). For comprehensive listings of gene expression by brain structure, go to the Search Annotations page.

Choose from the list below to view images with interesting gene expression in that structure. Click on a thumbnail to inspect an image in more detail. Switch to gene view.

Cerebellum (brightfield)


Agtr2

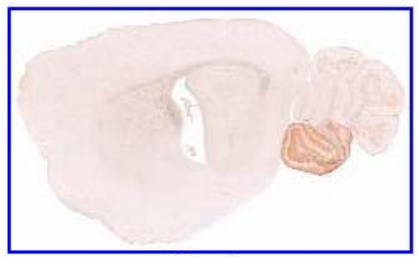

Agtr2


Agtr2


Arc


Atoh1


Barhl1


Ccnd2


Dhx57

Cerebellum

Contents [show]

Chinese Translation [edit]

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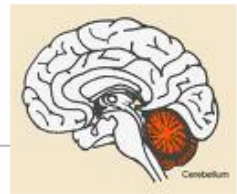

Functions [edit]

- Motor

Neurons [edit]

- Cerebellar Purkinje Neuron (edit/view)

Data Pages [edit]

[to be added]

Paper/Article Pages [edit]

[to be added]

External Web Pages [edit]

- GENSAT
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- 维基百科 (Chinese version of Wikipedia)
- ClinicalTrials.gov

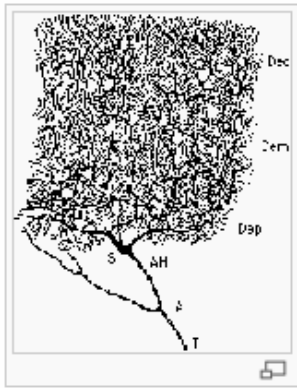
Category: Cerebellum

Cerebellar Purkinje Neuron

Contents [show]

Definition [edit]

- Principal neuron (projection neuron) of the cerebellar cortex; characterized by a pear shaped cell body, 1-2 primary dendrites and an elaborate dendritic tree heavily invested with dendritic spines.
- Large branching neurons of the middle layer of cerebellar cortex, characterized by vast arrays of dendrites; involved in controlling complex movements (CSP).



Region (of Brain) [edit]

Cerebellum

Neuronal Cell Membrane Properties [edit]

receptor: GABA, GABA receptor, GABA-A receptor, GABA-B receptor

current: I K Ca current, I K current

transmitter: GABA transmitter

Data Pages [edit]

- CCDB Cerebellar Purkinje Neuron
- ModelDB Cerebellar Purkinje Neuron
- NeuronDB Cerebellar Purkinje Neuron
- PDSP Cerebellar Purkinje Neuron

```
{{#ask: [[Category:Cerebellar Purkinje Neuron]] [[Category:Neuroscience Database]]
|format=ul
}}
```

Paper/Article Pages [edit]

[to be added]

External Web Pages [edit]

- NeuroMorpho.org
- GENSAT
- WikiPedia

Category: Purkinje Cell

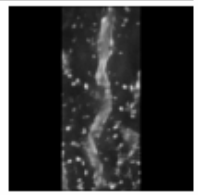
CCDB Cerebellar Purkinje Neuron

CCDB

Images of Cerebellar Purkinje Neuron

[edit]

- **Title:** spiny dendrite
- **Project Name:** Correlated Microscopy of Dendritic Spines
- **Description:** Measurements of spine parameters using light microscopy and electron tomography
- **Purpose:** how well dendritic spines can be detected and measured using LM
- **Species:** rat
- **Strain:** Sprague Dawley



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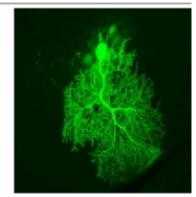


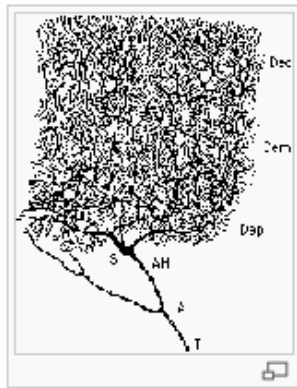
- **Title:** Intracellular injection of Purkinje neuron
- **Project Name:** Mouse BIRN test data
- **Description:** Neurolucida tracing of filled Purkinje neurons
- **Purpose:** To obtain multi resolution data for Mouse BIRN
- **Species:** mouse
- **Strain:** C57BL 6

Categories: Neuroscience Database | Cerebellar Purkinje Neuron

Cerebellar Purkinje Neuron

Contents [show]

Definition [edit]



- Principal neuron (projection neuron) of the cerebellar cortex; characterized by a pear shaped cell body, 1-2 primary dendrites and an elaborate dendritic tree heavily invested with dendritic spines.
- Large branching neurons of the middle layer of cerebellar cortex, characterized by vast arrays of dendrites; involved in controlling complex movements (CSP).

Region (of Brain) [edit]

Cerebellum

Neuronal Cell Membrane Properties [edit]

receptor: GABA, GABA receptor, GABA-A receptor, GABA-B receptor

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- NeuronDB Cerebellar Purkinje Neuron
- PDSP Cerebellar Purkinje Neuron

Paper/Article Pages [edit]

[to be added]

External Web Pages [edit]

- NeuroMorpho.org
- GENSAT
- WikiPedia

Category: Purkinje Cell

GABA-A receptor

Contents [show]

Definition [edit]

Combining with the amino acid gamma-aminobutyric acid (GABA, 4-aminobutyrate) to initiate a change in cell activity. GABA-A receptors function as chloride channels. (GO)

Neurons [edit]

- CA1 Pyramidal Neuron (edit/view)
- Cerebellar Purkinje Neuron (edit/view)

Data Pages [edit]

- ModelDB GABA-A receptor
- NeuronDB GABA-A receptor
- PDSP GABA-A receptor

Paper/Article Pages [edit]

[to be added]

External Web Pages [edit]

- ClinicalTrials.gov
- GO
- Wikipedia
- Proteopedia

Category: GABA-A receptor

PDSP GABA-A receptor

PDSP

Possible drug interactions with GABA-A receptor

- **receptor:** GABA A Alpha1Beta1Gamma2
- **small molecule:** Gamma-Aminobutyric acid
- **Ki value:** 77.62 nM

- **receptor:** GABA A Alpha1Beta2Gamma2
- **small molecule:** Gamma-Aminobutyric acid
- **Ki value:** 57.54 nM

- **receptor:** GABA A Alpha1Beta3Gamma2
- **small molecule:** Gamma-Aminobutyric acid
- **Ki value:** 21.37 nM

Categories: Neuroscience Database | GABA-A receptor

GABA-A receptor

Contents [show]

Definition [edit]

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Neurons [edit]

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- Cerebellar Purkinje Neuron (edit/view)

Data Pages [edit]

- ModelDB GABA-A receptor
- NeuronDB GABA-A receptor
- PDSP GABA-A receptor

Paper/Article Pages [edit]

[to be added]

External Web Pages [edit]

- ClinicalTrials.gov
- GO
- Wikipedia
- Proteopedia

Category: GABA-A receptor

Found 10 studies with search of: gaba-a receptor

Hide studies that are not seeking new volunteers.

1 Recruiting
Positron Emission Tomography (PET) Study With (11C) Flumazenil to Determine Central GABAA Receptor Occupancy of AZD6280
Condition: Anxiety
Interventions: Drug: AZD6280; Drug: (11C) flumazenil

2 Completed
Positron Emission Tomography (PET) Study With (11C)Flumazenil to Determine Central GABAA Receptor Occupancy of AZD7325
Condition: Anxiety
Interventions: Drug: AZD7325; Drug: Radioligand (11C) flumazenil

3 Recruiting
Study of GABA-A Receptors in the Generation of Tics in Patients With Tourette's Syndrome
Condition: Tourette Syndrome
Intervention:

4 Completed
Single Nucleotide Polymorphism (SNP) in Schizophrenia and Schizophrenia Spectrum Disorders: a Population Association Analysis With Hong Kong Chinese
Condition: Schizophrenia
Intervention: Procedure: Extraction of 10ml blood sample for extraction of genomic DNA using DNA purification kits

5 Recruiting
Intravenous Levetiracetam as First-Line Anticonvulsive Treatment in Patients With Non-Convulsive Status Epilepticus
Condition: Status Epilepticus, Non-Convulsive
Intervention: Drug: first-line i/v-levetiracetam

6 Recruiting
Brain Changes in Patients With Focal Hand Dystonia
Condition: Focal Dystonia
Intervention:

7 Active, not recruiting
Impact of GABA-Enhancing Agents on Cortical GABA Concentrations Across the Menstrual Cycle in Women
Condition: Healthy
Interventions: Drug: Fluoxetine; Drug: Zolpidem; Drug: Progesterone

8 Recruiting
GABA Mechanisms Underlying the Vulnerability to Alcohol Dependence
Condition: Alcoholism
Interventions: Drug: Thiopental; Drug: Placebo

Database and Literature

NIF Database Entry

page | discussion | view form | view source | history

NeuronDB

ID	nif-nif-709
Name	NeuronDB
Submitter	nif
Short Name	NeuronDB
Full Name	Database of membrane properties in neuronal compartments
URL	http://senselab.med.yale.edu/senselab/neurondb/default.asp
Entry Date	2006/06/26
Modification Date	2006/03/27
Cataloger	nif
Import Source	NDG
Foreign ID	28903
Adminstrative Contact Name	Gordon Shepherd
Adminstrative Contact Email	gordon.shepherd@yale.edu
Techical Contact Name	Luis Marenco
Techical Contact Email	lnm7@email.med.yale.edu
Resource Type	data resource (neuroscience data or findings).database (data sets), bibliographic resource (library/publisher or literature access)
Data Format	text, neuron hoc files

Literature

PubMed 18716656

Source	PLoS ONE. 2008 Aug 21;3(8):e3029
Title	GABA(A) receptor-mediated acceleration of aging-associated memory decline in APP/PS1 mice and its pharmacological treatment by picrotoxin
Authors	Yoshiike Y, Kimura T, Yamashita S, Furudate H, Mizoroki T, Murayama M, Takashima A
Affiliation	⚠
Abstract	Advanced age and mutations in the genes encoding amyloid precursor protein (APP) and presenilin (PS1) are two serious risk factors for Alzheimer's disease (AD). Finding common pathogenic changes originating from these risks may lead to a new therapeutic strategy. We observed a decline in memory performance and reduction in hippocampal long-term potentiation (LTP) in both mature adult (9-15 months) transgenic APP/PS1 mice and old (19-25 months) non-transgenic (nonTg) mice. By contrast, in the presence of bicuculline, a GABA(A) receptor antagonist, LTP in adult APP/PS1 mice and old nonTg mice was larger than that in adult nonTg mice. The increased LTP levels in bicuculline-treated slices suggested that GABA(A) receptor-mediated inhibition in adult APP/PS1 and old nonTg mice was upregulated. Assuming that enhanced inhibition of LTP mediates memory decline in APP/PS1 mice, we rescued memory deficits in adult APP/PS1 mice by treating them with another GABA(A) receptor antagonist, picrotoxin (PTX), at a non-epileptic dose for 10 days. Among the saline vehicle-treated groups, substantially higher levels of synaptic proteins such as GABA(A) receptor alpha1 subunit, PSD95, and NR2B were observed in APP/PS1 mice than in nonTg control mice. This difference was insignificant among PTX-treated groups, suggesting that memory decline in APP/PS1 mice may result from changes in synaptic protein levels through homeostatic mechanisms. Several independent studies reported previously in aged rodents both an increased level of GABA(A) receptor alpha1 subunit and improvement of cognitive functions by long term GABA(A) receptor antagonist treatment. Therefore, reduced LTP linked to enhanced GABA(A) receptor-mediated inhibition may be triggered by aging and may be accelerated by familial AD-linked gene products like Abeta and mutant PS1, leading to cognitive decline that is pharmacologically treatable at least at this stage of disease progression in mice.
MeSH Terms	
Substances	

Annotated Abstract: Advanced age and mutations in the genes encoding amyloid precursor protein (APP) and presenilin (PS1) are two serious risk factors for Alzheimer's disease (AD). Finding common pathogenic changes originating from these risks may lead to a new therapeutic strategy. We observed a decline in memory performance and reduction in hippocampal long-term potentiation (LTP) in both mature adult (9-15 months) transgenic APP/PS1 mice and old (19-25 months) non-transgenic (nonTg) mice. By contrast, in the presence of bicuculline, a GABA(A) receptor antagonist, LTP in adult APP/PS1 mice and old nonTg mice was larger than that in adult nonTg mice. The increased LTP levels in bicuculline-treated slices suggested that GABA(A) receptor-mediated inhibition in adult APP/PS1 and old nonTg mice was upregulated. Assuming that enhanced inhibition of LTP mediates memory decline in APP/PS1 mice, we rescued memory deficits in adult APP/PS1 mice by treating them with another GABA(A) receptor antagonist, picrotoxin (PTX), at a non-epileptic dose for 10 days. Among the saline vehicle-treated groups, substantially higher levels of synaptic proteins such as GABA(A) receptor alpha1 subunit, PSD95, and NR2B were observed in APP/PS1 mice than in nonTg control mice. This difference was insignificant among PTX-treated groups, suggesting that memory decline in APP/PS1 mice may result from changes in synaptic protein levels through homeostatic mechanisms. Several independent studies reported previously in aged rodents both an increased level of GABA(A) receptor alpha1 subunit and improvement of cognitive functions by long term GABA(A) receptor antagonist treatment. Therefore, reduced LTP linked to enhanced GABA(A) receptor-mediated inhibition may be triggered by aging and may be accelerated by familial AD-linked gene products like Abeta and mutant PS1, leading to cognitive decline that is pharmacologically treatable at least at this stage of disease progression in mice.

Category: PubMed Article

Semantic Markup

'''Annotated Abstract: '''Advanced age and mutations in the genes encoding [[protein::amyloid precursor protein]] (APP) and [[protein::presenilin]] (PS1) are two serious risk factors for [[disease::Alzheimer's disease]] (AD). Finding common pathogenic changes originating from these risks may lead to a new therapeutic strategy. We observed a decline in [[brain function::memory]] performance and reduction in [[brain region::hippocampus|hippocampal]] [[cellular mechanism::long-term potentiation]] (LTP) in both mature adult (9-15 months) transgenic APP/PS1 mice and old (19-25 months) non-transgenic (nonTg) mice. By contrast, in the presence of bicuculline, a [[receptor::GABA-A receptor|GABA(A) receptor]] antagonist, LTP in adult APP/PS1 mice and old nonTg mice was larger than that in adult nonTg mice. The increased LTP levels in bicuculline-treated slices suggested that GABA(A) receptor-mediated inhibition in adult APP/PS1 and old nonTg mice was upregulated. Assuming that enhanced inhibition of LTP mediates memory decline in APP/PS1 mice, we rescued memory deficits in adult APP/PS1 mice by treating them with another GABA(A) receptor antagonist, [[drug::picrotoxin]] (PTX), at a non-epileptic dose for 10 days. Among the saline vehicle-treated groups, substantially higher levels of [[junction::synapse|synaptic]] proteins such as GABA(A) receptor alphal subunit, PSD95, and NR2B were observed in APP/PS1 mice than in nonTg control mice. This difference was insignificant among PTX-treated groups, suggesting that memory decline in APP/PS1 mice may result from changes in synaptic protein levels through homeostatic mechanisms. Several independent studies reported previously in aged rodents both an increased level of GABA(A) receptor alphal subunit and improvement of cognitive functions by long term GABA(A) receptor antagonist treatment. Therefore, reduced LTP linked to enhanced GABA(A) receptor-mediated inhibition may be triggered by aging and may be accelerated by familial AD-linked gene products like Abeta and mutant PS1, leading to cognitive decline that is pharmacologically treatable at least at this stage of disease progression in mice.

Future Directions

- Use WikiNeuron to drive some of the BioRDF activities (with possible collaboration with other task forces such as LODD and SWAN/SIOC)
- Identify neuroscience/life science databases (e.g., NIF databases, SWAN, Neurocommons, Bio2RDF, BioGateway, so on)
- Use of ontologies to help annotate data content
- Automatic extraction and conversion of local data into wiki page format with annotation
- Automatic import of annotated data/paper pages
- Interface with HCLS KB (e.g., DBPedia interfaces with Virtuoso – DBPedia supports both SPARQL Endpoint and Open linked data)
- Visualization and cross-language
- Community participation
  - Neuroscience
  - Semantic Web
  - Semantic Wiki
  - Text mining
  - Linked Data
  - Ontology
  - Workflow

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Thanks
Questions?